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THESIS

Planning for a Department of Defense Mail Service Pharmacy System

by

Jonathan Claude Sherman

December 1991

Thesis Advisor: Keebom Kang

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This thesis provides a methodology for use in addressing whether or not the Department of Defense should alter the way in which it distributes medications to eligible beneficiaries. The possibility of providing centralized mail-order services as a means of filling prescriptions for maintenance medications is examined. Two major trade-offs are involved. First, the creation of Mail Service Pharmacies (MSP) will provide better services to eligible beneficiaries, including those previously lacking access to prescription services. This will lead to increased demand and costs. A method is provided for determining demand and the cost of medications required to support this demand. Second, the addition of mail-order services may require large capital expenditures for facilities and equipment. The trade-off is system-wide savings in inventory

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Planning for a Department of Defense Mail Service Pharmacy System

by

Jonathan Claude Sherman
Lieutenant Commander
United States Navy
Medical Service Corps
MHA, Tulane University, 1979

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

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ABSTRACT

This thesis provides a methodology for use in addressing whether or not the Department of Defense should alter the way in which it distributes medications to eligible beneficiaries. The possibility of providing centralized mail-order services as a means of filling prescriptions for maintenance medications is examined. Two major trade-offs are involved. First, the creation of Mail Service Pharmacies (MSP) will provide better services to eligible beneficiaries, including those previously lacking access to prescription services. This will lead to increased demand and costs. A method is provided for determining demand and the cost of medications required to support this demand. Second, the addition of mail-order services may require large capital expenditures for facilities and equipment. The trade-off is system-wide savings in inventory and related costs resulting from the consolidation of prescription dispensing services. MSP system alternatives are examined using a net present value approach. Examples are hypothetical except where stated otherwise.

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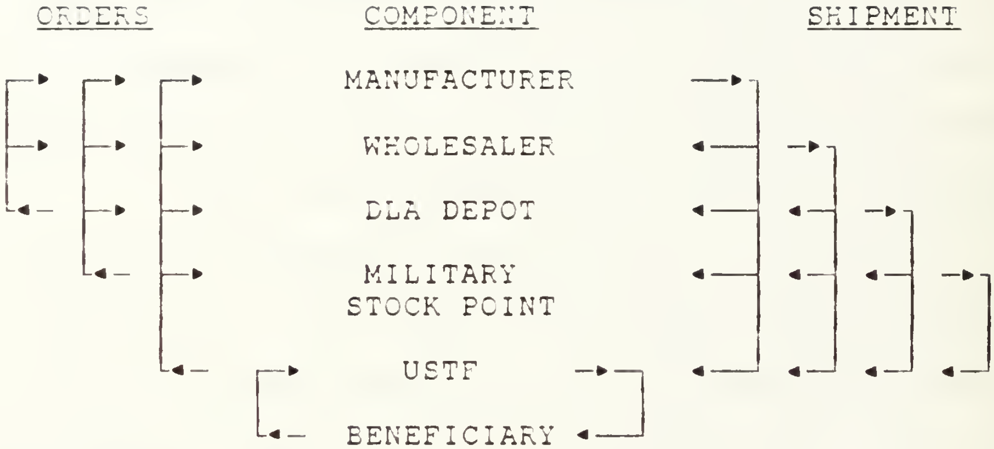
I. INTRODUCTION

A. DESCRIPTION - THE DECISION TO REPLAN

The design of a logistics system boils down to a series of decisions based on cost trade-offs. Not all decisions resulting in minimum costs are beneficial to an organization as a whole. For example, the decision to ship supplies to a customer by the cheapest means available (e.g., rail versus truck), may save a few dollars on transportation at the expense of the receiver having to carry extra inventory to cover the longer or more variable lead time.

In order to know if the initiation of a Mail Service Pharmacy (MSP) system is a good idea, it must be studied within the context of the logistics system in which it will operate. The Department of Defense (DoD) is responsible for providing health services to all military personnel, retired or on active duty and their dependents and/or survivors. Part of this responsibility is the provision of medications as prescribed by authorized personnel. It is this portion of the health care system that must be examined to determine the appropriateness and feasibility of a MSP sub-system.

A logistician's view of the DoD medication distribution system is shown in Figure 1. In the current system, pharmaceuticals are purchased by multiple military and Defense



DOD Medication Distribution System

Figure 1

Logistic Agency (DLA) material management organizations from commercial manufacturers and wholesale suppliers. Commercial suppliers in turn ship replenishment medications directly to a Uniformed Services Treatment Facility (USTF), or to a military or DLA warehouse for resale and distribution to multiple USTFs. Finally, USTF outpatient pharmacies, which may have to repackage drugs or formulate their own medications, dispense them to eligible patients per prescriptions written by authorized personnel.

A physical distribution system such as the one described above is not static. Changes in internal requirements and/or external pressures, may mean the system must change if it is to continue to function effectively. There are many reasons to replan a logistics system. These may include:

* Changes in the level of demand and/or its geographic dispersion.
* Changes in customer service requirements due to competing alternatives, policy revisions, or new service goals.
* Changes in product characteristics such as; weight, volume, value, or risk.
* Changes in the cost of physical supply and distribution where such costs are a significant percentage of the entire operation. (Ballou, 1985, p.276)

It could be further argued that in the pursuit of the goals (e.g., continual improvement) of Total Quality Leadership (TQL) adopted by the DoD, all logistics systems should be frequently scrutinized for potential improvement. However, due to the high cost in time and dollars of strategic planning, the author expects most TQL motivated improvements would involve micro level processes rather than at the macro level discussed in this thesis.

Has the logistics environment changed sufficiently to motivate DoD to replan its medication supply and distribution system? The answer is yes considering the following possibilities and facts:

* The number of eligible beneficiaries is expected to shrink as the size of the armed services is reduced over the next five years. This may promote calls for system downsizing and/or consolidation.[1]

* While the Armed Forces down sizes, the number of beneficiaries over the age of 45 should increase. Changing age demographics signals changing customer requirements.[2]

* As the number of military bases shrinks those beneficiaries living beyond 40 mile USTF catchment areas may increase. This may lead to increased use of the costly Civilian Health and Medical Program of the Uniformed Services (CHAMPUS) insurance program. A 1991 Navy study by the Bureau of Medicine and Surgery, showed that recapturing current CHAMPUS prescription filling workload done by the private sector could result in millions of dollars in savings by DoD.[3]

* At the present time, a significant portion of DoD's beneficiaries (i.e., those 65 years and older) are effectively denied the benefits of the current medication distribution system because of access problems (i.e., many do not reside near a USTF). They are further denied the use of CHAMPUS to partially cover prescription costs since Medicare eligibility precludes CHAMPUS use. Medicare, however, covers only those medications received as a hospital inpatient.

* One only needs to observe the long lines outside a typical USTF outpatient pharmacy to conclude that long

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[1] See Chapter III, Section B, p.29.

[2] See Chapter III, Section B, p.29.

[3] Phone interview on 10 September 1991 with LT T. Mahara, BUMED (MED-13), Washington, DC.

waiting times are a customer service problem. A MSP effectively reduces waiting times for those who use its services to zero.

- There is ample evidence in the spectacular growth of the private sector MSP industry, and as evidenced by the Veterans Administration's (VA) program, that MSPs are a viable medication distribution system alternative. The American Medical Association has given the mail order drug distribution method its stamp of approval. They also state, however, that it is probably the most appropriate for patients requiring medications to treat long-term chronic conditions. (Find/SVP, 1989, p.145)
- The costs of prescription drugs are the fastest rising component of health care costs, and as the number of older beneficiaries increases so will the use of maintenance medications to treat chronic or long-term conditions. (Horgan, 1989, p.I-5)

A decision to reduce system costs and provide better customer service requires a search for alternatives to alter the current distribution system. The author believes mail service offers great promise in both areas. This thesis examines how to determine the effects and the desirability of augmenting the current medication distribution system with a MSP sub-system.

B. SCOPE - HOW TO REPLAN

Many logistics and physical distribution system textbooks offer logistics planning models.[4] Magee (1967) suggests the decision to replan a logistics system requires the formation of two separate groups representing all functional areas.

---

[4] Three examples, other than those cited in the reference section of this thesis, that appear useful include: Attwood, Peter R., Planning a Distribution System, Gower Press Limited, London, 1971; Johnson, J. C. and D. F. Wood, Contemporary Logistics, Macmillan Publishing Company, New York, 1990; and Taff, Charles A., Management of Physical Distribution and Transportation, Homewood, Richard D. Irwin, Inc., Illinois, 1984.

The first group is a management supervisory committee whose tasks include:

- Establishing system objectives and policies.
- Ensuring adequate resources are available to those studying the problem.
- Reviewing the effectiveness and feasibility of proposed operations.
- Approving operating trials that are convincing to both higher authority and operating personnel.

The second group, a working analysis team, will:

- Design system alternatives by obtaining and analyzing detailed information about products, services, demand characteristics of customers, costs, and capabilities of existing systems, facilities and organizations.
- Analyze investment requirements (e.g., facilities, equipment, information systems, etc.) and estimate operating costs (e.g., labor, utilities, transportation charges, etc.) for each alternative.
- Implement the selected system, and train operating personnel in its principles and controls.

Magee also recommends that at least one member of the team should have continuing responsibility for design of improvements, operations review, and analysis of effects of future policy changes (Magee, 1967, pp.94-95). In our particular case, it is vital to appoint pharmacists to these two groups to take advantage of their knowledge of dispensing medications. For those charged with completing the actual analysis, knowledge of analytical methods is also necessary.

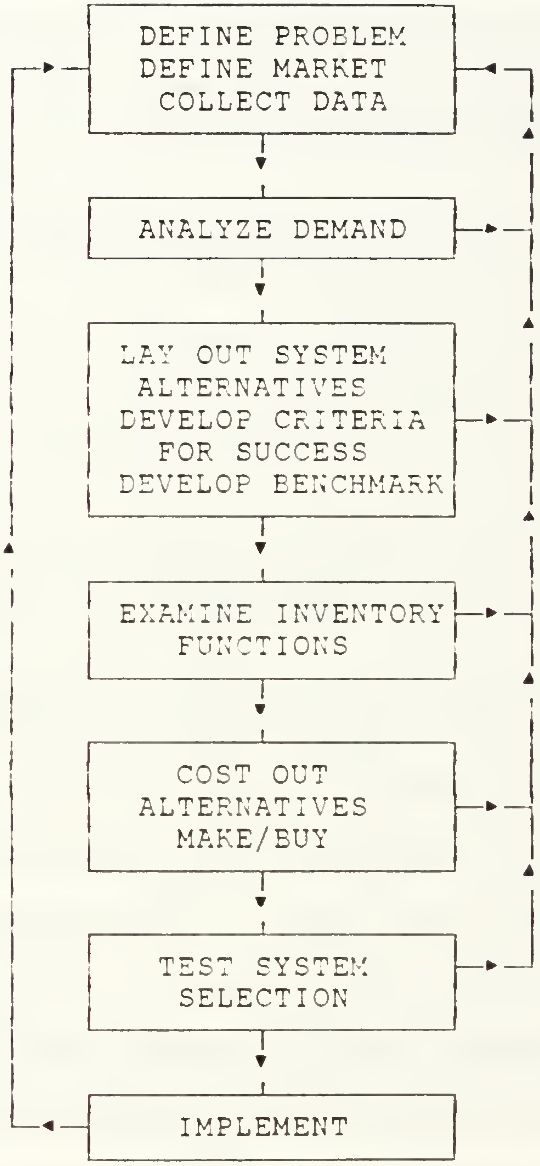
This thesis is offered as a starting point for accomplishing the first two tasks (i.e., system design and analysis) assigned to the working analysis team. In addition, methodologies are developed and illustrated to determine:

* Rough cut capacity requirements for a DoD MSP system (including those beneficiaries not using the system currently).

* Estimated cost savings from stock consolidation as compared to the estimated costs for creating and operating alternative MSP logistics systems.

Available data was inadequate for the purposes of providing valid rough estimates of the above measures. Though the methodology used to develop estimates is believed to be appropriate, the limited time frame for this thesis made data collection difficult. Therefore, all data, with the exception of beneficiary data obtained from the Defense Medical Information System (DMIS) and the Resource and Analysis Planning System (RAPS), have been developed for illustration purposes only. Additional data such as that obtained from a number of individual USTFs, as described in Chapter III, is required to obtain valid and useful working estimates.

Magee outlines seven steps which the working analysis team should follow to accomplish its first two tasks (Magee, 1967, pp.96-97). The analysis process outlined in Figure 2 is adapted from his descriptions. The succeeding chapters examine the first five steps in greater detail. The last two steps, involving testing and implementing the chosen system, occur after system design and cost analysis. They are



Logistics System Replanning Model

Figure 2

mentioned here only to close the loop for the entire logistics system planning process.

The structure of this thesis is as follows. Chapter II examines the requirements to gather, organize, and analyze data on the medication distribution market and its customers. Questions to be answered regarding our customers include:

- Who are our customers?
- What products and services do they require?
- How do we compare (e.g., cost, access, etc.) with other alternative medication distribution systems?

Market questions include:

- Where are our customers located?
- How are these markets served?
- How are customer demands influenced by age, sex, time period, etc. (i.e., who is prescribed what and how often)?

Chapter III reviews the requirement to collect and perform statistical analysis on demand and workload data. Forecasting of aggregate demand and item demand is examined as a means to determine system capacity requirements and inventory levels, respectively. Demand distribution and variability of demand by item, volume, and over time and geographic area are also discussed as they aid in the determination of safety stock requirements in relation to lead times.

In Chapter IV, layouts for different MSP medication distribution systems are presented. Layout considerations include; mix and location of MSPs and warehouse facilities, transportation modes and shipping costs, and relation to existing logistic systems. The development of criteria to measure success is also examined.

Chapter V discusses the selection of inventory management functions and their impact on inventory levels and costs. The connection between the level and cost of inventories and quality of customer service desired, and other inventory operational questions (e.g., pull systems, Just-In-Time, etc.) and costs (e.g., order, holding, transportation, etc.) are also examined.

Chapter VI reviews the requirements for cost analysis and the comparison of various system alternatives laid out in Chapter IV. The analysis of alternative logistic distribution systems, expected to yield maximum savings due to stock consolidation, is described to determine if cost savings are sufficient to cover required capital investment and operating costs or contract prices. The possibility of using a net present value analysis over a ten year period to compare selected MSP alternatives is examined with emphasis on stock consolidation obtained through centralization of MSP services.

Chapter VII presents conclusions and recommendations for consideration by those charged with policy and decision making responsibilities.

II. UNDERSTANDING THE MAIL SERVICE PHARMACY MARKET

To understand the MSP market one must examine the nature of the service to be provided, and who will use it. This chapter is divided into two sections to analyze these two elements.

A. THE NATURE OF THE SERVICE TO BE PROVIDED

There are primarily four channels through which pharmaceuticals are distributed in the private sector. They are:

- Consumer retail stores with approximately 72% of all sales.
- Hospitals, nursing homes, and ambulatory care centers accounting for about 23% of all sales.
- Mail Service Pharmacies representing 6% of all sales.
- Physicians' offices responsible for approximately 0.1% of all sales. (Find/SVP, 1989, pp.38-41)

We are fortunate to have a number of existing MSP logistics distribution systems to examine. They occur both in the private and public sectors. The VA first began mailing prescriptions to eligible veterans in 1946. In 1959, the American Association of Retired Persons (AARP) and the National Retired Teachers Association formed a nonprofit MSP service for their members. Finally, in 1963 the first for-profit MSPs opened targeting corporations, unions, and government employers. (Horgan, 1989, p.I-4)

The VA established its MSP system primarily to provide greater service and convenience to veterans who, for health reasons or otherwise, could not routinely pick up refills for long-term care medications. AARP's involvement resulted from its desire to provide reduced cost drugs of the highest possible quality to its members. Faced with the spiraling costs of providing health care coverage for their employees, corporations and governments are turning to MSPs to reduce expenses. (Enright, 1987, p.1871)

The types of pharmaceuticals available from MSPs vary somewhat. The overwhelming evidence, however, is that MSPs concentrate on processing new and refill prescriptions for maintenance drugs to treat long-term chronic conditions. Table 1 lists the top 20 classes, representing 95%, of drugs dispensed by MSPs in 1991. Virtually all of the ten highest volume prescription drug classes, accounting for 78.6% of the MSP market, represent maintenance-type drugs. The eleventh highest volume class, accounting for an additional 2.6%, happens to be for nonprescription or over-the-counter (OTC) vitamins. These too, however, are being prescribed as maintenance drugs. (IMS America, 1991, p.7)

MSPs receive few requests for acute care medications. However, they have been found, for the most part, to fill all prescriptions received. These include even difficult to handle controlled substances, anti-infectives, compounded drugs, and refrigerated items. (Horgan, 1989, pp.V-8, V-11)

TABLE 1

TOP TWENTY DRUG CLASSES
DISPENSED BY MAIL SERVICE PHARMACIES

RANK	USC2 CLASS & DESCRIPTION	% OF TOTAL ℞
1	31000 Cardiovasculars	29.1%
2	41000 Ethical Diuretics	8.3%
3	52000 Hormones	7.8%
4	64000 Psychotherapeutics	6.8%
5	09000 Ethical Antiarthritics	6.3%
6	28000 Respiratory Therapy	5.5%
7	23000 Antispasmodics	5.3%
8	39000 Diabetes Therapy	3.6%
9	72000 Thyroid Therapy	3.0%
10	32000 Cholesterol Reducers	3.0%
11	60000 Nutrients & Supplements	2.6%
12	61000 Ophthalmic Preparations	2.5%
13	02000 Analgesics	2.3%
14	15000 Systemic Anti-Infectives	1.9%
15	37000 Dermatologicals	1.5%
16	14000 Systemic Antihistamines	1.5%
17	67000 Sedatives	1.1%
18	34000 ℞ Cough/Cold Preparations	1.1%
19	12000 Anticonvulsants	1.0%
20	30000 Cancer Therapy	0.8%
	TOP 20 TOTAL	95.0%

The lopsided weighing in favor of maintenance drugs results from the fact that it is not practical to dispense medications for acute illnesses in a distribution system where the average MSP turnaround time is 33 hours (Horgan, 1989, p.V-7). This turn around time does not include the receipt of the prescription or shipment of the medication to the customer which could add three to four days on both ends. It is certainly possible to significantly reduce overall turnaround times through process improvements, the use of electronic mail or fax, and same day mail service. Cost-benefit analysis will be crucial to any decision to adopt these improvements.

The emphasis on maintenance drugs may also be accounted for by the fact that over 50% of all MSP sales are to persons 65 years or older, though they make up only approximately 38% of those eligible for MSP services (Horgan, 1989, p.IV-2).

MSPs enjoy numerous advantages over the three alternative distribution channels listed above. In addition to convenience for the customer, cost savings can be attributed to:

* Aggressive use of generic drugs in the absence of a brand name specification by the physician writing the prescription.

* Bulk purchasing methods yielding price discounts.

* Lower fixed costs and lower overhead by locating in lower cost areas and through consolidation.

* Higher inventory turnover rates due to the ability to concentrate on a smaller range of medications.

* Lower administrative costs due to the use of highly automated systems, and the practice of dispensing at one

time approximately three times the amount of a maintenance drug as retail pharmacies do. The justification for capital investments in automated systems is that they accomplish the mechanical tasks of dispensing medications faster and with fewer pharmacists. (Horgan, 1989, pp.V-14-V-23)

Disadvantages include:

- The addition of packing and shipping costs.
- The potential for waste under the policy of dispensing higher volumes (estimated to be 3-4% of total mail order drug volume), and through loss or breakage in shipment (Find/SVP, 1989, p.145).
- Loss of face-to-face contact between pharmacist and customer which could lead to misuse, mistakes, or adverse drug interactions.

MSPs have worked to counter the latter disadvantage by establishing such programs as:

- Toll free telephone numbers for customers to talk to pharmacists.
- Sending information pamphlets with medications.
- Maintaining customer profiles.
- Limiting the dispensing of certain drugs to a 30 vice 90 days supply.

These programs to date have been deemed adequate, though no studies have been published comparing their efficacy to other medication distribution channels. (Horgan, 1989, p.VI-6)

B. THE NATURE OF OUR CUSTOMERS AND THEIR REQUIREMENTS

The Defense Medical Information System (DMIS) provides a great deal of data concerning DoD eligible beneficiaries. Data is drawn from the Defense Enrollment Eligibility Reporting System (DEERS). The most current Health Data

Summary (Fiscal Year 1989) provides beneficiary data useful to this research by:

- Beneficiary category, age and sex.
- Catchment versus non-catchment area.
- Location by state.

According to the FY 1989 summary data, the total number of beneficiaries residing in the continental United States (CONUS) is 8,290,101. Of these, 1,880,500 are aged 45 to 64 (22.6%), and 859,578 (10.4%) are 65 years and older. These two age groups, making up 33% (2,740,078 customers) of our beneficiary population, can be expected to make the most use of a MSP filling prescriptions for maintenance medications.

There are no doubts about the convenience of MSP use. Beneficiary benefits would include:

- Avoidance of multiple trips to the pharmacy.
- Avoidance of long pharmacy waiting lines (i.e., waiting time is essentially zero for those who utilize the mail order service properly).
- Ability to obtain medications free of charge.

The latter benefit is of special importance to those who now must pay through the use of CHAMPUS or are over 65 years old and not residing near a USTF. The identification of this workload is especially important since it represents a potential increase in current outpatient pharmacy workload and costs.

The BUMED study, cited earlier, found that Navy USTFs were already filling 65% of all prescriptions obtained by beneficiaries outside of Navy USTF catchment areas. At the DoD level, total prescriptions filled by the private sector under CHAMPUS cost $75,000,000 last year.[5] The cost, types, and amounts of maintenance type drugs filled under CHAMPUS can be extracted from the CHAMPUS database, but this is expected to be a formidable task.

A determination of the numbers of beneficiaries eligible for CHAMPUS or medicare and residing outside of a medical catchment area, a so called "shadow population," can be extracted from DMIS. Beneficiaries are assigned to catchment and non-catchment area by zip codes. The FY 1989 Health Data Summary reports the number of non-catchment beneficiaries (residing in CONUS) between the ages of 45 to 64 and 65 years or older to be 615,265 and 292,163, respectively. The total of 907,428 is 33% of the catchment area beneficiaries (2,740,078) of the same age group.

Maintenance medication use for this group can be estimated based on current USTF outpatient pharmacy fill rates for similar age groups. Data on prescriptions filled by age is not generally available at the USTF level, since age is not normally required when a prescription is filled. A program to sample current data should be initiated to estimate the additional workload and cost represented by this group.

---

[5] Phone interview on 28 August 1991 with Mr. P. Greggor, DOD Comptroller.

In the absence of this data, the 33% figure, derived above and applied as a percentage of the total number of prescriptions filled, can serve as an estimate of the approximate increase in workload resulting from serving the shadow population.

The knowledge of who our customers are and what they require forms the basis for a critical analysis of our current system. The service shortfalls and areas for potential improvement identified above, indicate adding a mail order option to our current logistics system deserves serious consideration. To determine the scope of such an effort it is necessary to collect data and analyze the potential demand for this service.

III. COLLECTION AND ANALYSIS OF DEMAND STATISTICS

The demand for a MSP system within DoD can be determined through the study of the quantities of pharmaceuticals (i.e., those expected to be dispensed by MSPs) currently dispensed and an estimation of usage by those beneficiaries not currently using the system. To do this, it is necessary to focus on two types of demand measures. First, an aggregate measure of demand is needed to project the capacity requirements of the proposed MSP system. Second, item demand, determined after gathering data on the types, quantities, and distribution of medications issued, ís vital to MSP inventory management.

A. DATA COLLECTION

Prescriptions filled appears to be a good aggregate measure of demand for services, and can be collected by type of medication being prescribed. It is important to know the breakdown of prescriptions filled over time and by age group. This data will aid in analyzing demand variations and forecasting demand against forecasted changes in beneficiary age mix.

Item demand and the shape of its distribution is important to current operations to determine warehouse cycle and safety stock levels. It can be determined from a review of historical records maintained by USTF level Material Management departments.

The required prescriptions filled data, with the exception of CHAMPUS data cited in Chapter III, is currently available at the USTF level only. It will have to be extracted and rolled up from the Tri-Service Micro Pharmacy System (TMPS) or the Tri-Service Pharmacy (TRIPHARM) system currently located in all USTFs filling a minimum of 5,000 prescriptions per month or assigned a pharmacist.[6]

To obtain a rough estimate of capacity requirements as represented by prescriptions filled, the top 20 drug classes dispensed by civilian MSPs were split into five groups. The largest commercial MSP company, MEDCO Containment Services, Inc. (MEDCO), was contacted for assistance in identifying one drug in each group that was representative of that group in terms of volume dispensed and cost. They were unable to do this in a reasonable period of time. As a result, a military pharmacist was contacted and asked to suggest a drug representative of each group. These five drugs are listed in Table 2 along with the group of drug classes they represent.

Next, the 127 USTFs identified in the DMIS FY 1989 health data summary were split into five groups based on the total number of beneficiaries they serve (i.e., those within their catchment area only) aged 45 years and above. A statistical

---

[6] Phone interview on 27 August 1991 with LT Hurd, Naval Data Services Center, Bethesda, MD.

TABLE 2

TOP TWENTY DRUG CLASSES BY GROUP DISPENSED BY MAIL SERVICE PHARMACIES (WITH REPRESENTATIVE DRUG)

RANK	USC2 CLASS & DESCRIPTION	% OF TOTAL ℞
1	31000 Cardiovasculars	29.1%
GROUP 1 - 29.1%	Representative Drug - Nifedipine	
2	41000 Ethical Diuretics	8.3%
3	52000 Hormones	7.8%
4	64000 Psychotherapeutics	6.8%
5	09000 Ethical Antiarthritics	6.3%
GROUP 2 - 29.2%	Representative Drug - Furosemide	
6	28000 Respiratory Therapy	5.5%
7	23000 Antispasmodics	5.3%
8	39000 Diabetes Therapy	3.6%
9	72000 Thyroid Therapy	3.0%
10	32000 Cholesterol Reducers	3.0%
GROUP 3 - 20.4%	Representative Drug - Albuterol	
11	60000 Nutrients & Supplements	2.6%
12	61000 Ophthalmic Preparations	2.5%
13	02000 Analgesics	2.3%
14	15000 Systemic Anti-Infectives	1.9%
15	37000 Dermatologicals	1.5%
GROUP 4 - 10.8%	Representative Drug - Ibuprofen	
16	14000 Systemic Antihistamines	1.5%
17	67000 Sedatives	1.1%
18	34000 ℞ Cough/Cold Preparations	1.1%
19	12000 Anticonvulsants	1.0%
20	30000 Cancer Therapy	0.8%
GROUP 5 - 5.5%	Representative Drug - Diphenhydramine	
	TOP 20 TOTAL	95.0%

analysis of this data as well as the USTF chosen to represent each group is shown in Table 3. The mean and median for each of five groups are close enough to indicate a basically symmetric distribution within each group. Thus, an USTF serving a beneficiary population close to the group mean will be representative of all USTFs in that group. Details of these groups of USTFs is shown in Appendix A.

TABLE 3

STATISTICAL ANALYSIS OF 127 USTFS
BASED ON NO. OF BENEFICIARIES AGED 45 YEARS PLUS
(WITH REPRESENTATIVE USTF)

	NO. OF BENEFICIARIES AGED 45 PLUS				
	0-15000	15000-25000	25000-45000	45000-65000	65000+
BENEFI-CIARIES	541843	613715	394413	207856	76432
% TOTAL	30%	33%	22%	11%	4%
MEAN	6947	19179	32868	51964	76432
STD DEV	4197	2878	3808	5223	0
MEDIAN	6660	18897	33396	51368	76432
MAX	14770	24991	38051	59549	76432
MIN	50	15228	25613	45571	76432
NO. USTFS	78	32	12	4	1
REP USTF	VANDENBURG	LETTERMAN	BETHESDA	PORTSMTH	SAN DIEGO

Outpatient pharmacies of the five representative USTFs were contacted and requested to provide the number of prescriptions filled by month over the last twelve months for each of the five drugs. The documents used to request this information appear in Appendix B. In most cases, despite computer support, the requested information for all strengths of the drugs in question was deemed excessive by the USTFs' pharmacists. Information requests in these cases were therefore limited to a single National Drug Code (NDC) or form and strength for each drug.

Information was received only from San Diego Naval Hospital, and only for a six month period. Prescriptions filled by age group was not available.

Extrapolation of this data to the entire DoD is complicated by incomplete data. Since San Diego Naval Hospital serves only 4% of the catchment area beneficiary population over the age of 45 years, extrapolation would not result in valid estimations. Therefore, the data presented in Table 4 through Table 8, showing the approximate annual requirement to fill prescriptions for each of the five drugs, is developed only to illustrate the methodology proposed in this thesis to estimate capacity requirements.

Step 1 is to record prescription usage by the five representative USTFs. This is shown in Table 4.

TABLE 4

PRESCRIPTIONS REPORTED BY FIVE REPRESENTATIVE USTFS FOR FIVE REPRESENTATIVE DRUGS

	USTF 1	USTF 2	USTF 3	USTF 4	USTF 5
NIFEDIPINE	734	1969	3500	5250	7636
FUROSEMIDE	742	1989	3537	5305	7716
ALBUTEROL	1053	2825	5022	7532	10956
IBUPROFEN	911	2443	4343	6515	9476
DIPHENHYD	435	1165	2072	3108	4520

In step 2, as illustrated in Table 5, since a representative USTF was selected based on its closeness to the mean number of beneficiaries served over the age of 45 years old in its group, the number of prescriptions reported is multiplied by the number of USTFs in the group.

TABLE 5

PRESCRIPTIONS REPORTED BY REPRESENTATIVE USTF
MULTIPLIED BY THE NUMBER OF USTFS IN GROUP

	78	32	12	4	1	
NIFEDIPINE	57270	62997	41998	20999	7636	190900
FUROSEMIDE	57870	63657	42438	21219	7716	192900
ALBUTEROL	82170	90387	60258	30129	10956	273900
IBUPROFEN	71070	78177	52118	26059	9476	236900
DIPHENHYD	33900	37290	24860	12430	4520	113000

						1007600

Step 3, as shown in Table 6, is to reduce the number of prescriptions by the estimated acute care prescription requirements.

TABLE 6

TOTAL PRESCRIPTIONS REDUCED BY ESTIMATED
ACUTE CARE REQUIREMENTS FOR PATIENTS
UNDER FIFTY YEARS OLD

NIFEDIPINE	190900				190900
FUROSEMIDE	192900				192900
ALBUTEROL	273900	*	49%[*]	=	134211
IBUPROFEN	236900	*	30%	=	82170
DIPHENHYD	113000	*	32%	=	75808
	--------				--------
TOTAL	1007600				675989

This was done by using the Physician Drug Diagnosis Audit (Scott-Levin, 1991). This document reports the percentages of prescriptions written by civilian physicians for individual drugs by age group. Given the fact that older patients are heavier users of maintenance medications, a prescription written for a patient aged 50 years and older is considered to represent a maintenance medication vice an acute care requirement. To determine the numbers of prescriptions dispensed as maintenance medications the total prescription figures developed in step 2 were multiplied by the percentage of prescriptions written for persons aged 50 years and older. These percentages for the drugs; albuterol, ibuprofen, and diphenhydramine, were 49%, 30%, and 32%, respectively. The other two drugs; furosemide and nifedipine are prescribed almost exclusively as maintenance medications.

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[*] This column shows the percentage of the prescriptions written for patients aged 50 years and above.

Each of the five drugs represents a different percentage of the total volume of prescriptions filled from the top 20 classes of drugs currently dispensed by civilian MSPs. Table 7 illustrates step 4 where the number of prescriptions written for a drug are divided by the percentage of total volume it represents. The results (i.e., estimated total prescription volume) are very nearly the same. An average of these five total prescription volume (i.e., 8,175,200 which is obtained by adding the estimated totals and dividing by 5) will provide a rough estimate of DoD's annual MSP prescription fill rate for catchment area beneficiaries.

TABLE 7

TOTAL MAINTENANCE MEDICATION PRESCRIPTIONS FOR THE FIVE DRUGS BASED ON PERCENTAGE OF TOTAL VOLUME FOR CIVILIAN MSP SERVICES

NIFEDIPINE 190900 / .024 = 7954167
FUROSEMIDE 192900 / .023 = 8386957
ALBUTEROL 134211 / .017 = 7894765
IBUPROFEN 82170 / .010 = 8217000
DIPHENHYD 75808 / .009 = 8423111
-------- --------
TOTAL 675989 40875999 / 5 = 8175200

In step 5, as shown in Table 8, adding 33% of the total number of prescriptions found in step 4 to itself, accounts for the additional workload generated by providing access to this service to the shadow population.

TABLE 8

TOTAL DoD PRESCRIPTIONS PLUS 33% TO ACCOUNT FOR SHADOW POPULATION

8175200 * 1.33 = 10873016
=========

One weakness of this method is its reliance on civilian MSP prescription volume. The population this volume is based on is different from the military population. It is possible that military beneficiaries are healthier than their civilian counterparts due to better health care and lifestyle experienced while in the armed forces. It is important to develop a military version of Table 2 above to reflect this difference.

Warehouse inventory requirements (i.e., average annual dollar value of inventory) for each of the five representative drugs was requested from the same USTF Material Management

Department. Again, as with the pharmacies, some Material Management Departments limited their research to a single NDC for each drug. Additional cost data (e.g., carrying costs, ordering cost, etc.) was solicited in an attempt to gauge their effect on savings, in addition to stock consolidation, resulting from MSP centralization. Three of the five USTFs (i.e., San Diego, Portsmouth, and Letterman) provided the requested information. The documents used to request the above information appear in Appendix E.

Beyond the cost of stock held in individual USTF pharmacies, which is minimal compared to total inventories, it is important to determine the dollar amount of inventory supporting the number of prescriptions being filled. The calculations are identical as for the determination of prescriptions filled, but are based on average annual inventories maintained in USTF warehouses and percentage of total annual average inventory value. Again, insufficient data was available to produce a valid estimate. Table 9 therefore, is for illustrative purposes only. As shown in the table, the inclusion of the shadow population would require the value of USTF warehouse stock to increase under the current medication distribution system.

The useability of these estimates will be greatly enhanced by:

* A more scientific selection of representative drugs which must be representative in terms of volume dispensed and inventory dollar value.

TABLE 9

ESTIMATION OF DoD AVERAGE ANNUAL INVENTORY FOR PRESCRIPTION DRUGS TO BE FILLED BY MSP (ALL FIGURES ARE IN $)

STEP 1: AVERAGE INVENTORY AS REPORTED BY FIVE REPRESENTATIVE USTFS FOR FIVE REPRESENTATIVE DRUGS

	USTF 1	USTF 2	USTF 3	USTF 4	USTF 5
NIFEDIPINE	15615	42405	75387	113090	164480
FUROSEMIDE	13477	36671	65193	97790	142240
ALBUTEROL	25690	66980	122467	183700	267000
IBUPROFEN	20091	53942	99719	143578	208940
DIPHENHYD	5019	13994	24970	37319	54280

STEP 2: REPORTED INVENTORY FOR REPRESENTATIVE USTF MULTIPLIED BY THE NUMBER OF USTFS IN GROUP

	79	32	12	4	1	
NIFEDIPINE	1233585	1356960	904644	452360	164480	4112000
FUROSEMIDE	1064683	1173472	782316	391160	142240	3556000
ALBUTEROL	2029510	2143360	1469604	734800	267000	6680000
IBUPROFEN	1587189	1726144	1196628	574312	208940	5010000
DIPHENHYD	396501	447808	299640	149276	54280	1816000

						21174000

STEP 3: TOTAL INVENTORY FIGURED BY ESTIMATED ACUTE CARE REQUIREMENTS BASED ON CIVILIAN PRESCRIPTIONS WRITTEN BY AGE GROUP

NIFEDIPINE	4112000		4112000
FUROSEMIDE	3556000		3556000
ALBUTEROL	6680000	* 49% =	3273200
IBUPROFEN	5010000	* 40% =	2004000
DIPHENHYD	1816000	* 92% =	1670720
	--------		--------
TOTAL	21174000		14615920

STEP 4: TOTAL MAINTENANCE MEDICATION INVENTORY FOR THE FIVE DRUGS BASED ON PERCENTAGE OF TOTAL VALUE OF CIVILIAN MSP INVENTORIES

NIFEDIPINE 4112000 / .024 = 171333333
FUROSEMIDE 3556000 / .023 = 154608696
ALBUTEROL 3273200 / .017 = 192541176
IBUPROFEN 2004000 / .010 = 200400000
DIPHENHYD 1670720 / .009 = 185635556
-------- ---------
TOTAL 14615920 904518761 / 5 = 180903752

STEP 5: TOTAL DoD INVENTORY PLUS 33% TO ACCOUNT FOR SHADOW POPULATION
180903752 * 1.33 = 240,601,990

- Development of data revealing the volume of drug dispensing by drug and USC2 class, and percentage of dollar value of military inventories.

- The collection of prescription data and inventory values for all appropriate (i.e., those normally prescribed as maintenance medications) forms and strengths of a selected drug.

- Collection and use of actual historical and/or concurrent data representing at least two years of the current system's operations

B. DEMAND ANALYSIS

Once the demand data above has been collected it can be analyzed to forecast logistics requirements. Of particular interest are capacity requirements necessary to handle demand variations.

We assume that aggregate demand for all maintenance medications will not vary much over short periods of time, and is relatively smooth with the exception of a long-term upward trend. This upward trend is predicted based on forecasts of growth in the numbers of beneficiaries over 45 years of age obtained from the Resource Analysis and Planning System (RAPS).

RAPS combines data from the Fiscal Year 1992 Program Objectives Memorandum personnel end strength figures, and retiree and dependent data provided by the DoD Comptroller and Actuary, respectively. RAPS projects a 9.3% increase in the beneficiary population aged 45 years and over (2,740,078 in FY 1989 to 2,995,049 in FY 1999 including catchment and non-catchment) residing in CONUS by FY 1999. In comparison, total number of beneficiaries residing in CONUS is expected to decline 5.7% (8,290,101 to 7,818,947) over the same period.

One serious flaw in the RAPS projections is that while it takes the impending five year, 25% manpower drawdown into account, it does not account for the rapid redeployment of troops from Europe to CONUS expected to occur in the near future. In any case, this should have minimal effect on the size of the beneficiary population aged 45 and over which is of concern to this thesis.

As the number of beneficiaries over the age of 45 increases, it is reasonable to expect that maintenance medication usage will also increase. To confirm the relationship between the number of beneficiaries and the number of prescriptions filled one would need to collect and plot historical data for both factors. A correlation coefficient could then be calculated and regression analysis performed to more accurately predict capacity requirements. Lack of data does not permit this to be accomplished in this thesis.

For purposes of illustration only, the ratio of increase is estimated to be 1:1. This relationship, assuming it is a linear one, and using aggregate demand as determined from the example in Section A for FY 91 as a base (includes shadow population), is displayed in Table 10. By FY 1999 the number of prescriptions to be filled by a MSP system shows an increase of 6.8% over FY 1991 demand.

The demand for individual pharmaceuticals may be expected to show more variation over time and to be less smooth than aggregate demand for prescription services. Some causes for variations would include:

* Physicians often prescribe different drugs for the same condition.

* The onset of a particular illness, and therefore the drug that will be required to treat it, cannot be predicted with certainty.

* Not knowing how long a patient will have to stay on a particular medication.

TABLE 10

MSP WORKLOAD PROJECTIONS (FY 1992 - FY 1999)
AS RELATED TO BENEFICIARY POPULATION PROJECTIONS
FOR THE SAME PERIOD (BASE YEAR IS FY 1991)

FISCAL YEAR	BENEFICIARIES 45 YEARS OLD+	PRESCRIPTIONS FILLED
FY 91	2789844	10873016
FY 92	2812978	10902053
FY 93	2832441	11037765
FY 94	2852689	11116109
FY 95	2874107	11198947
FY 96	2899201	11295880
FY 97	2928191	11407712
FY 98	2961305	11535276
FY 99	2995049	11665239

PRESCRIPTION DEMAND PERCENTAGE CHANGE (FY91 TO FY99) - 6.8%

It would therefore be more appropriate to attempt to forecast demand over much shorter time periods. Historical projection methods based on past data provide reasonable forecasts for periods extending out to about six months (Ballou, 1985, p.83).

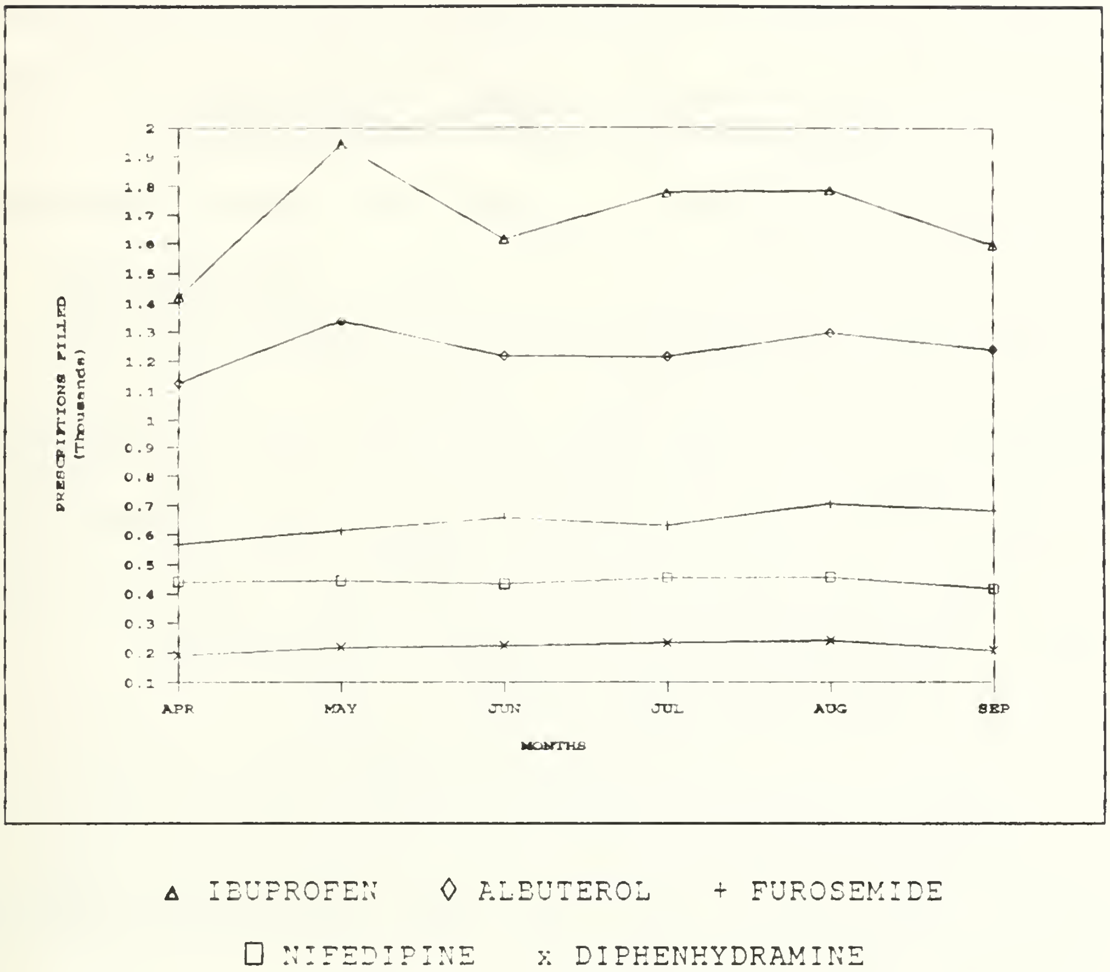
Item demand forecasts are used, along with the inventory management approach chosen, to determine inventory requirements to meet normal demand. The amount of safety stock required is a function of:

- Demand forecast errors.
- Lead time variability.
- The level of customer service to be provided.
- The demand distribution or pattern.

The latter information is also used in determining savings from stock consolidation efforts brought about by centralizing the dispensing of medications in an MSP environment. Stock consolidation is examined in Chapter VI in analyzing costs associated with different MSP alternatives.

In order to determine the distribution of demand for an item, historical data (e.g., prescriptions filled) can be analyzed over a period of time, preferably two years. The demand distribution by month for the five drugs at the San Diego Naval Hospital outpatient pharmacy for April through September 1991 is shown in Figure 3. The demand for maintenance medications would not be expected to show a great deal of variation over time. With data from only one USTF for a short six months period, however, it is difficult to draw any conclusions.

Demand over geographic area does not appear to be a factor in the analysis in this thesis. However, it would be required to aid in deciding where to locate MSPs. Since the exclusive means of delivery of medications to customers from MSPs is through the U.S. Postal Service and United Parcel Service



Demand Distribution by Month for Five Drugs at NH San Diego

Figure 3

(UPS), the impact on costs and service level of a facility's proximity to service hubs and the market must be considered. (Horgan, 1989, p.V-9)

With knowledge of the aggregate demand for services (i.e., number of prescriptions to be filled over time), it is now possible to investigate the best way to provide these services.

IV. LOGISTIC SYSTEM ALTERNATIVES

Figure 1 in Chapter I shows the existing medication distribution system. In this chapter, the advantages and disadvantages of three possible MSP alternatives with which to augment this system are considered. One of these alternatives, to locate MSPs with existing USTF pharmacies (either all or a select few), appears to be impractical. Generally, there isn't adequate space for expansion within USTFs to accommodate even limited MSP operations.[5]

The remaining two MSP alternatives are:

- Create a stand alone MSP or multiple MSPs.
- Contract for MSP services from sources outside DoD.

Further, there is no reason why these alternatives cannot be combined to meet requirements.

In examining alternative approaches to obtaining the goals of improved customer service and reduced operating expenses, it is important to understand how they will interact with existing systems. For example, it is not reasonable to expect the existing DoD supply distribution system to change very much to accommodate this new sub-system, thus allowing little flexibility or innovation to cut costs. Further, it is expected that those beneficiaries not currently obtaining medications from USTF pharmacies will use a DoD MSP service, thus increasing system costs while decreasing CHAMPUS expenses.

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[5] Phone interviews on 21 October 1991 with LCDR C. Beneke from the Defense Medical Facilities Office (DMFO), Defense Medical Systems Support Center, and Mr. F. Webb from the Facilities Branch (BUMED-42), Bureau of Medicine and Surgery.

A. STAND ALONE MSP

While it is possible to exclude existing USTFs as potential MSP sites through discussions with knowledgeable persons, the possible configurations for a stand alone MSP system would be greatly aided by computer simulation. Simulation aids in the analysis of such factors as:

- Number and location of MSPs and warehouses.
- Different customer service levels.
- Transportation mode or distance.

Sensitivity analysis helps to determine which alternatives will deliver the desired level of customer service for a given cost, or vice versa.

Within the limited time allotted to thesis preparation, it was not possible to examine sensitivities using computer simulation. An appropriately designated working analysis team as described in Chapter I might even decide it is too expensive to pursue. In any event, the focus of this thesis remains the formulation of a methodology to determine savings resulting from the consolidation of maintenance medication dispensing within a MSP system.

A stand alone system of MSPs pivots around the question of what is the optimal number and combination of MSPs and the warehouses which serve them. Figure 4 diagrams a system with a single super MSP served directly by suppliers, through a single intermediate warehouse, and multiple warehouses. Figure 5 diagrams a system with multiple MSPs.

The function of an intermediate warehouse is to consolidate orders from suppliers to take advantage of cost savings associated with shipping full truck or car loads. Replenishment lead time, however, may be adversely affected. This is an example of an idea which may generate some resistance from the existing supply system.

The main advantages of a single, centralized MSP serving all eligible beneficiaries include:

* The ability to take maximum advantage of USTF system wide stock consolidation savings.

* The potential to design and operate a highly efficient pharmacy operation based on having the day's workload of prescriptions available at the start of the production shift.

* Reduced customer waiting time at individual USTF outpatient pharmacies due to reductions in USTF outpatient pharmacy workload. This will occur only to the extent staffing is not cut commensurate to workload reduction.

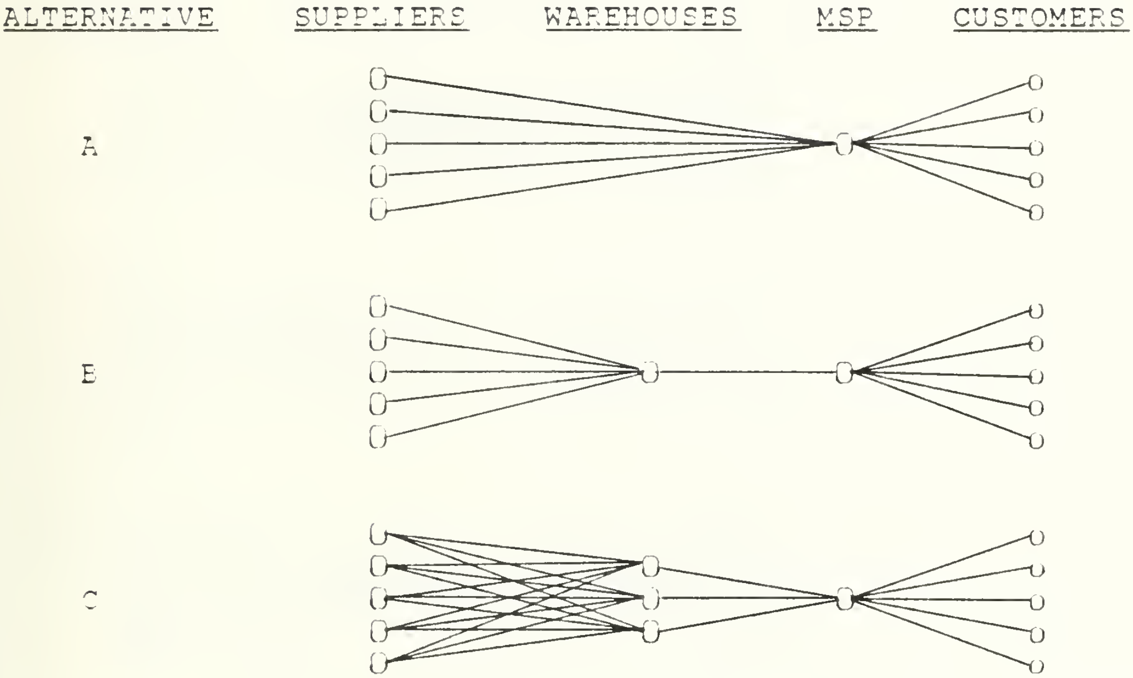
* Lower transportation and inventory costs than multiple smaller MSPs.

Disadvantages include:

* Lack of backup mail order capabilities.

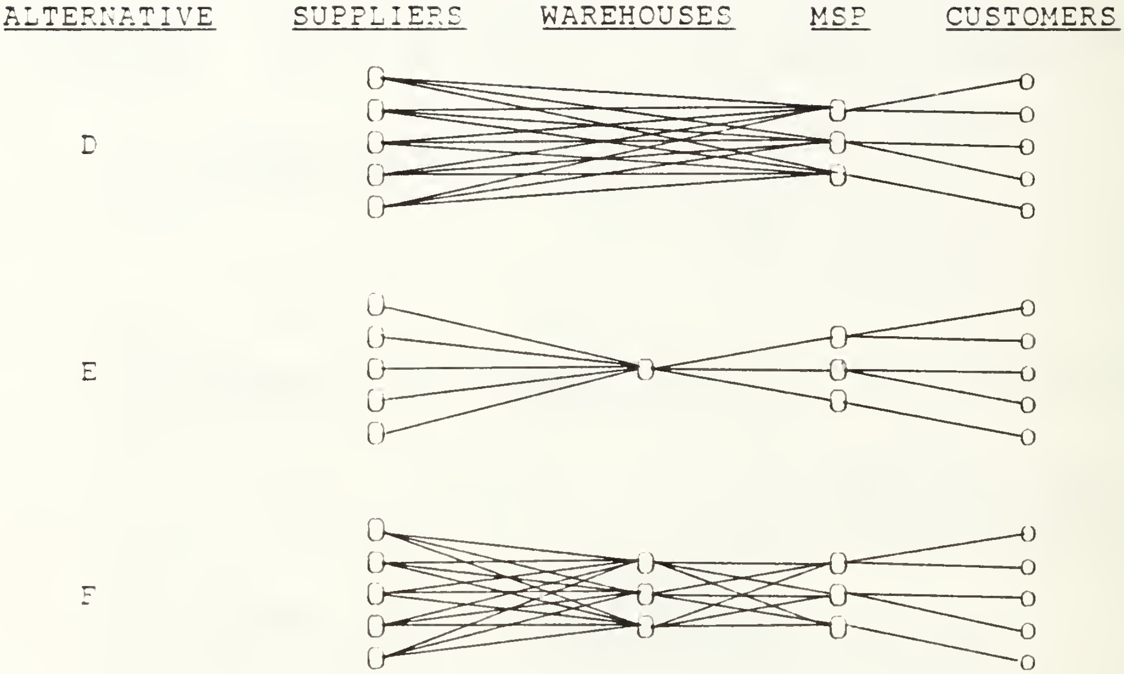
* Disruptions accompanying opening up new distribution channels.

* A requirement for a major investment in facilities, equipment and manpower.



Single Centralized MSP Alternatives

Figure 4



Multiple Centralized MSP Alternatives

Figure 5

* The potential for higher operation costs to ensure control versus multiple smaller MSPs.

In addition to the advantages for the single MSP option, other advantages of a multiple MSP system are:

* The existence of a backup mail order capability.

* The potential for better operational control due to smaller facility size.

* More location options.

Disadvantages include:

* Less stock consolidation savings.

* Greater investment costs to the extent services duplicate those of a single centralized MSP.

* Higher supplier transportation costs and requirement to carry more inventory to provide the same customer service level as a single centralized MSP.

Factors to consider in deciding where to locate a single or multiple free standing MSPs are the same. These factors might include:

* Proximity to the USPS, UPS hubs, and DoD supply centers. MSP location, in this regard, is important to rapid prescription turnaround time and lower shipping costs.

* Proximity to suppliers to minimize shipping costs.

* Proximity to existing supply lines to minimize shipping costs.

* Ability to make use of existing facilities and land to minimize capital investments.

* Availability of an appropriate infrastructure at a reasonable cost to support the facility.

* Availability of required manpower at a reasonable cost with the appropriate skill mix.

* A desirable quality of life.

* Low area construction costs.

These location factors are mentioned here because they can greatly affect the cost of the final distribution system design. Some of these factors are used in the cost analysis developed in Chapter VI. Others are not since they do not affect the choice of a system, but only where to locate it. As explained earlier, the proximity of an MSP to its customers is not a major factor since medications are mailed or shipped to them. However, whereas UPS has an excellent record of on time delivery, U.S. Postal Service delivery is much more variable. This is especially true for mail delivery from one coast to the other.[9] Since less variability is a positive factor in customer satisfaction (i.e., more certainty about prescription turnaround time), this fact is an argument for locating a single MSP facility in the center of the country or having at least two MSPs (e.g., one on each coast).

One other location question requires investigation. Locating MSPs next to major military or DoD supply centers will have a positive impact on:

* Reducing transportation costs.
* Minimizing inventory requirements.
* The potential to avoid duplication of purchasing and receiving services.

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[9] Interview on 6 September 1991 with Dr. C Trietsch, Associate Professor of Operations Management and Logistics, Naval Postgraduate School, Department of Administrative Sciences, Monterey, CA.

D. CONTRACTING OUT

Under this alternative one must consider contracting out for all or part of the required service. The potential providers of MSP services are:

- Private sector for-profit companies.
- AARP, a nonprofit organization.
- VA.

The private sector and AARP may be excluded due to the fact that the government commands a significant price advantage in purchasing pharmaceuticals. This can be as high as 30%[11] and cannot possibly be expected to be absorbed by the private sector. There is the possibility, however, of providing the required pharmaceuticals to these sectors as government furnished supplies to be used only in filling DoD prescriptions.

These government discounts have decreased significantly for pharmaceuticals purchased under the Federal Supply Schedules due to the passage this year of PL 101-508 Title 4 (i.e., the Pryor Amendment). This law requires pharmaceutical manufacturers to sell their products to health care providers serving Medicare program patients at the lowest price charged to preferred customers. This requirement exempted DLA depot stocked items, however, so DoD still retains a price advantage. Further DoD and VA exemptions to this legislation are being sought from the Congress.[illegible]

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[11] Phone interview on 10 September 1991 with LT T. Mahara, BUMED (MED-13), Washington, DC.

The VA currently is in the process of centralizing its MSP system within its four regions (i.e., Northeast, Southern, Central, and Western). They have tested the centralized concept on the East and West Coasts, and found it provides superior service at reduced cost to maintaining MSPs at each individual VA hospital. These new centralized MSPs will rely heavily on automated filling of prescriptions.[illegible]

Under the current climate of huge budget deficits and a shrinking DoD budget, sharing agreements between government agencies are highly desirable. Any sharing agreement will have to be carefully negotiated, and a make/buy analysis performed following the selection of the favored in-house distribution system. The overwhelming advantage of this alternative is that drug stocks and workload can be reduced system-wide without additional capital investments in facilities and equipment.

C. CRITERIA FOR SUCCESS

It is important to determine criteria for success as a means to evaluate results provided by any test of the chosen system.

[illegible] Phone interview on 12 September 1991 with Mr. J. Morgan, Deputy Assistant Secretary of the Navy for Support and Families, Washington, DC.

[illegible] Phone Interview on 24 September 1991 with Mr. J. Ogden, Director, Pharmacy Operations, Veterans Administration, Washington, DC.

They are also useful in communicating results to the management supervisory committee who will have to present the proposal to DoD decision makers.

Criteria for success can be developed from policies provided to the analysis team by management, and where applicable, from performance statistics obtained from the current DoD medication distribution system and existing MSP logistics systems. One source of criteria is requirements related to service. Service categories, in addition to the level of customer service a system provides, include:

* Response time or service cycle - "...the time elapsed from receipt of a customer order until the goods are delivered to the customer."
* Shipping accuracy - "...the ratio between the number of shipments that have the right items, correct count, and correct address, and the total number of shipments in a given time period."
* Shipment condition - "...the ratio between the number of shipments delivered in good condition and the total number of shipments dispatched." (Robeson, 1985, pp.168-169)

Information on the latter two service categories for commercial MSP operations is anecdotal, but is apparently no worse than any other type of pharmacy system (Horgan, 1989, p.VI-6).

Unit costs, inventory turnover rates, and staffing may also be compared; however, this is only appropriate to do between facilities or systems of similar size and scope. Horgan (1989) provides most of this information for the commercial MSP system. He reports, however, that pharmacies participating in his study did not provide full cost disclosures for industry competition reasons.

Each distribution system alternative described above carries with it a profound effect on the levels of inventory, (a major cost factor), that ultimately will be required for efficient and effective operation. Inventory levels are also a function of the inventory system under which it is managed.

V. INVENTORY MANAGEMENT

The objective of inventory management is to "...establish the order quantity level and the timing of the placement of the order that will minimize total inventory costs." (Ballou, 1985, p.359) At its simplest level, management decisions involve trade-offs between the cost of carrying inventory, the cost of procurement, and out-of-stock penalty costs. These costs are affected by such factors as:

- Demand and lead time variability.
- Customer service level.
- Existing system inventory practices.

A. MANAGEMENT SYSTEM SELECTION

Inventory management system selection will be heavily influenced by the choice of a distribution system alternative. For example, existing storage space limitations or the design of new space will affect the size and frequency of supply replenishment. Consideration must also be given to the internal operation of a MSP, the design of which is an important part of the task assigned to the analysis team.

For an examination of the work flow processes of a USTF outpatient pharmacy, the reader is referred to Bosch (1991). In his thesis, Bosch uses Total Quality Management theory and tools to show how outpatient pharmacy operations may be improved.

The process of filling prescriptions at an MSP can be compared to a multi-product manufacturing assembly process. At a MSP, orders (i.e., prescriptions) are received by mail, fax, or electronic mail. Once sorted, they are delivered to an assembly queue for a particular shift. Assemblers, whether human or machine, pull the appropriate medication, place it in the appropriate container, and push it out to be shipped to customers. Quality checks are accomplished at various points in the process.

The advantage a MSP has over a USTF outpatient pharmacy is that workload, while not constant, is not dependent on the random arrival of individual customers. However, this thesis deals with the management of inventory prior to the MSP prescription filling process (i.e., bulk stock management vice floor stock).

To manage bulk stocks, item demand over time can be forecasted for short time periods based on historical data. Further, since demand is not derived (i.e., a filled prescription is a completed order and not part of a predictable production schedule) it will be managed under a pull system. In a pull system, supply replenishment orders originate from the user as opposed to the next higher echelon organization pushing supplies into the pipeline.

The next step is to determine the methods by which inventory requirements are set, and how and when orders are placed. Currently, USTFs order the majority of their pharmaceuticals from the DLA's Defense Personnel Support Center (DPSC), Philadelphia, PA. For those USTFs with purchasing authority, remaining requirements are procured directly from manufacturers or wholesalers, for the most part, using pre-negotiated Federal Supply Schedule (FSS) or VA contracts.

It is extremely difficult to limit the number of commercial suppliers of pharmaceuticals that an MSP will have to deal with. This is due to the proprietary nature of most drugs, and the requirement to provide a particular drug without substitution when a physician prescribes it by name.

One way to simplify and reduce the cost of the inventory management process is to standardize inventory as much as possible (Ballou, 1985, pp.281-282). This can be done by creating a standard MSP formulary, and providing this information to those who write prescriptions and who use the mail service system. The decision to control the types of medications to be dispensed by MSPs must be made by the management supervisory committee since physician and customer opposition to the limitations is to be expected .

The required use of traditional supply procurement channels and methods provides very little flexibility in inventory management. Just-In-Time (JIT) ordering systems may be practical, however, for tablet and capsule medications dispensed by automation. Significant dollar savings are possible through the procurement of bulk pharmaceuticals (e.g., packed in drums of 50,000 versus bottles of 100). Not all commercial companies will sell drugs in this fashion.[13] JIT or a Kanban system should certainly be applied in the design of MSP internal operations.

Methods currently in use throughout DoD for managing cycle stock (i.e., stock required to meet average demand), safety stock (i.e., stock required to prevent stockouts), and stock in the supply pipeline are principally traditional Economic Order Quantity (EOQ), Reorder Point, and Safety Stock calculations.

D. CUSTOMER SERVICE LEVEL

For political reasons, the customer service level must be set by the management supervisory committee. It is the key to determine the amount of safety stock held in inventory to cover the time between order placements and receipts.

An often used and easily understood customer service level definition is the probability of being able to fill a customer's order out of existing inventory. For example, setting a service level of 99% requires that an average of 99 prescriptions out of 100 will be filled immediately. Prescriptions not filled due to stockout will, of course, be filled, but at the added expense of going off-line to do so. Prescription turn-around-time will be adversely affected as well. Currently, USTFs managing Navy Stock Fund (NSF) assets are required to set their customer service levels or fill rate at 85% or higher.[14] The three reporting USTFs in this thesis indicated they are operating at 90%, 96%, or 97%.

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[13] Phone interview of 3 October 1991 with Mr. B. Sherman, Product Manager (Retired), Schering Corporation, Kennelworth, NJ.

C. EOQ MODEL

The EOQ model and its derivatives have a number of advantages in calculating inventory levels for large numbers of individual items. Though the basic model assumes that demand, lead time, and costs are known with certainty, it can be made to account for some differences and still retain its simplicity in calculation. Quantity discounts, storage limitations, unshared storage space, and demand and order lead time variations can be dealt with directly or at least approximated. Once the EOQ is established and the safety stock quantity is determined, then the reorder point can be calculated.

Quantity discounts on purchases of pharmaceuticals should only be taken where inventory turnover is high enough to ensure customers have sufficient time to use them before expiration dates are reached. There is the further danger of waste due to drug recalls, or the development of new drugs or treatment procedures rendering stocks obsolete.

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[14] Fleet Material Support Office (FMSO) Instruction 4400.12J, *Instructions for Management of Navy Retail Supply Support System Material*, 8 March 1989

D. LEAD TIME

Safety stock is required to counter the effects of demand and lead time uncertainty. Under the current state of the art, the EOQ model becomes complicated when the attempt is made to account for both demand and lead time uncertainties. Instead, lead time may be taken as a given and an approximate solution is derived. (Ballou, 1985, p.388)

Procurement Administrative Lead Times (PALT), however, are far from certain in the DoD supply system. PALT includes the time it takes the ordering facility to process an order and for the supplies to arrive from the supplier. Ordering facilities should be able to fairly estimate the time it takes them to process an order. The remaining PALT is more uncertain.

When dealing with DoD supply organizations, shipment lead times are based on the priority assigned to the order by the ordering facility. Each priority code provides the ordering facility with a lead time window within which they can expect to receive their order. For example, Navy USTFs requesting routine replenishment can expect to receive their order within 30 to 90 days from receipt of that order by a DoD supplier. The ordering facility can either use the longest expected lead time or track lead time to determine its distribution and select a lead time with an acceptable probability of occurring.

Some discretion in the management of lead times and transportation selection is allowed when purchasing directly from commercial companies. Reduction in lead time and variability to achieve smaller inventories is a matter of choosing to spend more money on a faster, more reliable form of transportation, or choosing better vendors.

With the required decisions made regarding inventory management choices (i.e., maintain status quo), it is now possible to assign costs to each distribution system alternative for comparison purposes.

VI. COST ANALYSIS AND EVALUATION OF ALTERNATIVES

The goal of this chapter is to describe a method to obtain a least cost alternative from those identified in Chapter IV. Taking a micro-level view, alternatives would be tested for sensitivity to different levels of customer service. Different alternatives will exhibit differing amounts of cost savings or increases based on how the system is set up (e.g., number and location of facilities, choice of transportation mode, degree of production automation, etc.).

This thesis, however, is concerned with making a decision at the macro-level. Therefore, alternatives are compared at a single customer service level only, since the overall objective is to show that savings from centralization will justify the adoption of a MSP service. The customer service level is fixed at 85% per FMSO instruction.

As the hypothetical examples will illustrate, costs for each alternative chosen for analysis are projected out for ten years. Initial investments in facilities and equipment are made at the beginning of year 0. One year is allowed for construction. Initial investment in inventory is made at the end of year 0, but is negated by an expected one time savings from stock consolidation DoD-wide. Operating costs are incurred at the end of each year (beginning with year 1), and are also partly negated by expected savings from consolidation.

The net present value (NPV) is determined for each alternative. A positive NPV will indicate the alternative is worthy of consideration given that it will improve medication distribution services for a lower overall total cost. If all alternatives show a negative NPV, the least negative will provide the best return if the decision is made to institute MSP services.

Only those alternatives showing the greatest promise of savings from stock consolidation, through the centralization of MSP services at three or fewer locations or by contracting out, are analyzed.

A. RELEVANT COSTS

Three categories of costs useful in analyzing alternative systems in order to compare them with each other and then to the current system are:

* Relevant costs: out-of-pocket costs and those not considered sunk costs.
* Fixed costs: costs that do not vary over some relevant level of production volume.
* Variable costs: costs that vary as production volume varies.

Estimated costs, whether fixed or variable, must be relevant to the decision to alter the current medication distribution system. Costs must also be compared using the same time span. An annual comparison seems appropriate to this study, and must account for the additional workload expected from the shadow population.

At a minimum, the following relevant costs would be computed for comparative purposes:

- Investments in facilities and equipment.
- Investment in inventory.
- Inventory carrying costs.
- Cost of operations (e.g., labor, utilities, maintenance, etc.)
- Transportation costs (based on; mode, distance, rate structures, and in-transit inventory carrying costs).

For reasons cited below transportation costs are not included in the cost analysis examples.

To calculate the cost of facilities, the Defense Medical Facilities Office (DMFO) provided a rough dollar cost per square foot of $60 to construct facilities necessary to handle DoD's projected capacity requirements. They also pointed out that this cost would vary significantly depending on geographic location of the facility. Where facilities already exist without alternative uses, of course, it is appropriate to include only those costs necessary to make them suitable for use. If space is to be leased rather than constructed or purchased, annual lease costs should be used.

Facility size is based on the number of prescriptions expected to be filled at that facility. Excerpts from A DoD Space Planning Criteria guide of 1 August 1991, provided by DMFO, provides a means of converting number of prescriptions filled into pharmacy square footage requirements. The guide is used in this thesis, though it is recognized the requirement is really for a material distribution type space rather than a pharmacy.

The facility must be able to expand capacity to meet growing demand. Using the FY 1999 prescription filled projection of 11,665,239 from Table 10 and DoD space planning criteria, the cost of facilities is as follows:

- Single MSP: 11,665,239 prescriptions.
  (900 sqft + (11,610,239 * 100/10,000)) * $68 = $7,956,162
- Two MSPs: 5,832,620 prescriptions each.
  2 * (900 sqft + (5,777,620 * 100/10,000)) * $68 =
  $7,979,763
- Three MSPs: 3,888,413 prescriptions each.
  3 * (900 sqft + (3,833,413 * 100/10,000)) * $68 =
  $8,003,763

Information systems, equipment purchases, installation, and training costs should also be included (Magee, 1967, p.105) MEDCO and the VA were asked to provide some of these costs for different size facilities, but were unable to comply in the allotted time. Facilities and equipment costs are considered one time costs given this thesis does not analyze operations out beyond ten years. Beyond ten years, equipment may have to be replaced or facilities upgraded. For the following NPV analysis examples, investment in equipment is set at 20% of facility construction costs as follows:

- Single MSP: $7,956,162 * 20% = $1,591,232
- Two MSPs: $7,979,763 * 20% = $1,595,953
- Three MSPs: $8,003,763 * 20% = $1,600,753

Investments in inventory for each alternative distribution system are valued at actual cost, the estimation of which is key to a determination of cost savings from consolidation. Beyond an initial inventory investment at the end of year 0, inventories will increase with increased workload as described in Chapter III. Further, an inflation rate of 10.2% [15] is appropriate to factor in the rising cost of pharmaceuticals which have been rising faster than the general inflation rate.

The amount of stock required by the MSP is determined based on the 85% FMSO directed customer service level and demand for medications. The initial investment is developed by graphing the relative frequency of monthly demand for a drug or class of drugs, and then selecting the quantity which will ensure that 85% of all orders will be filled. Inadequate data was available for this purpose. Therefore, for purposes of illustration only, a single MSP, two MSPs, and three MSPs will operate with 60%, 70%, and 75% of the current system's requirements of $240,601,990 from Table 9, respectively as follows:

- Single MSP: Initial inventory requirement.
  $240,601,990 * 60% = $144,361,194
- Two MSPs: Total initial inventory requirement.
  $240,601,990 * 70% = $168,421,393
- Three MSPs: Total initial inventory requirement.
  $240,601,990 * 75% = $180,451,493

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[15] This is the 1990 calendar year inflation rate for prescription drugs as identified by the U.S. Department of Labor, Bureau of Labor Statistics, CPI Detailed Report, January 1991, p.18.

These figures will be offset by the initial reduction in inventories system-wide estimated to be $240,601,990. The net one time savings under each alternative is as follows:

- Single MSP:
  Net savings = $240,601,990 - $144,361,194 = $96,240,796
- Two MSPs:
  Net savings = $240,601,990 - $168,421,393 = $72,180,597
- Three MSPs:
  Net savings = $240,601,990 - $180,451,493 = $60,150,497

Annual inventory carrying costs are a function of the inventory management system used and the number of warehouses supporting the system. "For a given inventory management system, as the number of warehouses increases, the regional inventory needed to support a given sales level increases." (Robeson, 1985, pp.180-181) Inventory carrying costs include:

- Capital costs of inventory investment.
- Order processing costs.
- Storage space costs.
- Inventory risk costs. (Robeson, 1985, pp.280-296)

Determination of the capital cost of inventory is much more appropriate to private sector enterprises since it involves knowledge of alternative types of investments. For this reason, cost of capital is not estimated here. Instead, this thesis focuses on the different levels of inventory investment required for different MSP alternatives.

From the author's experience and the data provided by the participating USTFs, the cost to process a normal stock replenishment order is approximately $65. Ordering costs would be expected to decline with a reduction in inventories due to fewer orders. Reductions in the number of orders placed are a source of cost savings due to consolidation, as well as being a relevant factor in comparing alternative MSP configurations.

Storage space costs are largely fixed and irrelevant when costing out inventories. Any variable storage costs (e.g., inventory spot checks) will be minimal.

The most obvious component of inventory risk cost is obsolescence due to a drug reaching its expiration date, or one which falls out of favor with prescribing physicians. Damage and shrinkage (i.e.,theft) can also be obtained from historical data. Intuitively, one might expect inventory risk costs to be reduced as inventories are reduced through consolidation. This relationship and its magnitude can only be proved using regression analysis.

Inventory carrying costs have been estimated to be at least 25% per year of the value of the inventory over a broad range of industries (Robeson, 1985, p.619). These costs, however, should be offset by a similar 25% savings system-wide for a net positive annual savings of $60,150,498 (i.e., 25% * $240,601,990). For the NPV analysis example initial carrying costs are as follows:

- One MSP: 25% * $144,361,194 = $36,090,299
  Net savings = $60,150,498 - 36,090,299 = $24,060,199

- Two MSPs: 25% * $168,421,393 = $42,105,348
  Net savings = $60,150,498 - $42,105,348 = $18,045,150

* Three MSPs: 25% * $180,451,493 = $45,112,873
  Net savings = $60,150,498 - $45,112,873 = $15,037,625

The VA was asked to provide estimates for annual operating costs for various sized operations, but were unable to comply. The average annual operating cost plus profits for civilian MSPs has been estimated to be 20% of sales revenue, including costs applicable to DoD USTFs worth 16.41%. The remaining 80% of sales revenue is the actual cost of the pharmaceuticals dispensed.(Horgan, 1989, p.V-19) For a DoD USTF sales revenue would equate to the cost of the pharmaceuticals dispensed. Lack of data for costs of pharmaceuticals requires, for illustration purposes, the annual cost of drugs dispensed be represented by the initial investment in inventory for each alternative multiplied by an inventory turnover rate of 10.9 (Horgan, 1989, p.V-21).

Initial annual operating costs would be offset by similar savings from system-wide consolidation for a net cost savings of $430,362,374 (i.e., 16.41% * ($240,601,990 * 10.9)). Annual operating costs for this example are as follows:

* Single MSP:
  16.41% * ($144,361,194 * 10.9) = $258,217,424
  Net savings = $430,362,374 - $258,217,424 = $172,144,950

* Two MSPs:
  16.41% * ($168,421,393 * 10.9) = $301,253,661
  Net savings = $430,362,374 - $301,253,661 = $129,108,713

* Three MSPs:
  16.41% * ($180,451,493 * 10.9) = $322,771,781
  Net savings = $430,362,374 - $322,771,781 = $107,590,593

Annual operating costs are accrued beginning at the end of year 1 and are projected out eight additional years. This is illustrated in Table 11. Cost projections take into account workload increases resulting from an increase in beneficiary population as described in Chapter II. NAVCOMPTNOTE 7111 CH-1 of 1991 provides annual inflation rates for operating funds through FY 1997. An average annual inflation rate of 3.67% is used.

Transportation costs of shipments to USTFs and MSPs by suppliers are expected to remain relatively unchanged. This will occur if MSPs are established on existing DoD bases where supply lines are already in place.

B. EVALUATION OF ALTERNATIVES

Evaluation of alternatives has been limited to those which show the greatest promise for savings due to stock consolidation. Thus, the focus is on the alternatives offering the greatest amount of centralization to include:

- Construction of a single stand alone MSP.
- Construction of two stand alone MSPs.
- Construction of three stand alone MSPs.

Contracting out is considered in Section C.

Table 11 presents the NPV analysis, using the costs and savings derived in Section A, required to cost out the three MSP alternatives. An initial cash outflow for capital investments in facilities and equipment is required. This is followed by a one time net cash savings when the initial investment in inventory for the MSP system is offset by stock draw-downs at individual USTFs. Finally, both annual

TABLE 11

NET PRESENT VALUE ANALYSIS AND COMPARISON OF THREE MSF ALTERNATIVES (ASSUMING 10% ROI & 3.67% INFLATION)

			YEAR 0	YEAR 1	YEAR 2	YEAR 3
	NET PRESENT VALUE	FACILITY +EQUIPMNT COSTS	INVENTORY INVESTMNT SAVINGS	CARRYING + OPERATING SAVINGS	CARRYING + OPERATING SAVINGS	CARRYING + OPERATING SAVINGS
ONE MSF		($9,547,394)	$96,240,796	$24,060,199	$26,514,339	$29,218,802
				$172,144,950	$178,462,669	$185,012,249
TOTAL	$719,494,279	($9,547,394)	$96,240,796	$196,205,149	$204,977,008	$214,231,051
TWO MSFs		($9,578,916)	$72,160,597	$18,045,150	$19,885,754	$21,914,101
				$129,108,713	$133,847,003	$138,759,168
TOTAL	$537,424,421	($9,578,916)	$72,160,597	$147,153,863	$153,732,757	$160,673,269
THREE MSFs		($9,604,516)	$60,150,497	$15,037,625	$16,571,462	$18,261,751
				$107,590,593	$111,539,168	$115,632,655
TOTAL	$446,377,200	($9,604,516)	$60,150,497	$122,628,218	$128,110,630	$133,894,406

YEAR 4	YEAR 5	YEAR 6	YEAR 7	YEAR 8	YEAR 9
CARRYING + OPERATING SAVINGS	CARRYING + OPERATING SAVINGS	CARRYING + OPERATING SAVINGS	CARRYING + OPERATING SAVINGS	CARRYING + OPERATING SAVINGS	CARRYING + OPERATING SAVINGS
$32,199,120	$35,483,430	$39,102,740	$43,091,219	$47,466,523	$52,330,149
$191,802,198	$198,841,339	$206,138,816	$213,704,111	$221,547,052	$229,677,829
$224,001,318	$234,324,769	$245,241,556	$256,795,330	$269,013,575	$282,007,977
$24,149,340	$26,612,570	$29,327,055	$32,318,414	$35,614,893	$39,247,612
$143,851,650	$149,131,006	$154,604,113	$160,278,064	$166,160,290	$172,256,373
$168,000,990	$175,743,576	$183,931,168	$192,596,499	$201,775,183	$211,505,984
$20,124,450	$22,177,144	$24,439,212	$26,932,012	$29,679,077	$32,706,343
$119,876,374	$124,275,837	$128,836,760	$133,565,069	$138,466,907	$143,548,642
$140,000,823	$146,452,980	$153,275,972	$160,497,081	$168,145,984	$176,254,985

inventory carrying costs and operating costs for the MSP system provide net cash savings through cost reductions at USTFs. The NPV was determined using a 10% rate of return normally acceptable to DoD.

When the NPV and stock consolidation savings for each alternative are compared, the single MSP facility alternative shows the greatest promise. This comparison is, of course, far from the whole story, and is illustrated only to reveal the great potential for cost savings through consolidation resulting from the centralization of MSP services.

As discussed in Section A, the potential savings due to stock consolidation under each of these alternatives offsets the initial investment in inventory. Centralization of services allows one to provide the same customer service level with less stock. Pharmaceutical stocks at the USTFs may be reduced by an amount of stock somewhat less than that supporting the dispensing of maintenance medications by the MSP. The amount of the reduction will not be equal since some residual stock must remain to handle acute care, inpatient care, and emergency requirements.

C. CONTRACTING OUT ANALYSIS

After determining a least cost alternative MSP logistics system, it should be compared to contracting out with the VA and commercial operations using the make/buy break-even analysis method. Here it is important to consider only relevant costs and to leave out costs or savings that will occur regardless of which solution is chosen. Thus, any savings from the current system associated with adopting a MSP service is disregarded.

VA officials have indicated that some type of cost reimbursement per prescription filled would have to be negotiated. Since many different medications of varying cost will be dispensed, an average or unit cost per prescription filled will have to be estimated for analysis purposes. The correctness of the answer to the make/buy question will depend heavily on the accuracy of prescription demand forecasts, and a fair cost per prescription determination.

To perform this analysis, the total cost to buy (TC_b) prescriptions is set equal to the total cost to make (TC_m) prescriptions to determine the demand at which DoD will break even. $TC_b = P * D$, while $TC_m = V * D + FC$ (where P, represents price; D, demand; V, unit variable cost; and FC, fixed cost). FC is the cost of setting up the MSP facility. Setting the two equations equal to each other and solving for D gives: $D = FC / P - V$. For demand greater than D, the total cost to buy is lower.

D. BENCHMARKING

Before the decision to make and/or buy MSP services is made, the proposed medication distribution system, including an MSP alternative, must be compared to the current one (i.e., no MSP option) in terms of cost and performance. This practice is known as benchmarking, and is basic to any decision to institute a MSP service.

Table 12 provides a format for comparing the current USTF medication delivery system to a single, stand alone, centralized MSP. The costs of the current DoD pharmacy system are developed and placed in the column marked "BENCHMARK: CURRENT SYSTEM". Next, the cost of a MSP system is developed as described in the preceding chapters. These costs are combined with those of the current system, and placed in the column marked "SINGLE CENTRAL MSP". The bottom line will show what it will cost (there could possibly be a cost savings) to improve the existing DoD medication distribution system. Based on figures in Table 12, the current system with a Single Central MSP is more economical than the existing system alone in the long run.

TABLE 12

BENCHMARKING

BENCHMARK COMPARISON OF CURRENT AND POTENTIAL MEDICATION DISTRIBUTION LOGISTICS SYSTEM		
COST TYPE	BENCHMARK: CURRENT SYSTEM	WITH SINGLE CENTRAL MSP
PHARMACEUTICAL INVENTORY COSTS		
INVENTORIES	$657,845,000	$561,605,000
ORDER PROCESSING	$65,468,000	$55,345,000
STORAGE	$46,788,000	$40,659,000
RISK	$52,205,000	$41,244,000
PHARMACY FACILITY AND EQUIPMENT COSTS		
CAPITAL	$78,573,000	$88,121,000
PHARMACY OPERATIONS COSTS		
MANPOWER	$592,504,000	$472,003,000
OVERHEAD	$284,339,000	$232,695,000
TRANSPORTATION COSTS		
SUPPLIER TO USTF OR MSP	$98,676,000	$94,741,000
MSP TO CUSTOMER	$0	$8,799,000
SYSTEM PARAMETERS		
CUSTOMER SERVICE LEVEL	86%	86%
NUMBER OF PHARMACIES	127	128
TOTAL SYSTEM COSTS	$1,876,398,000	$1,595,212,000

VII. CONCLUSIONS AND RECOMMENDATIONS

Due to a lack of data, the methodology provided above to determine the demand for distribution of maintenance medications by mail service and the application of NPV analysis to MSP alternatives is just that; a methodology. It is extremely difficult to draw conclusions either for or against DoD adoption of an MSP system from the numerical results calculated as hypothetical examples only. Data collection was seriously hampered by repeated computer hardware and software failures as reported to the author by the USTFs participating in this study.

The collection of the necessary data and its application to the methodology above should provide an accurate financial picture of the consequences of adding mail order services to the existing DoD health care system. It should reveal cost savings from:

* Consolidation of inventories (greatest under the contracting out or single centralized MSP alternatives).

* Workload reduction in USTF pharmacy and material management operations due to consolidation effect of a centralized MSP.

* Economies of scale in centralizing workload at one or a few locations (assuming MSP services are accomplished in-house vice being contracted for). This includes system wide reductions in inventory carrying costs and operating costs.

* Efficient in-house operations due to specialization in maintenance medications,and where high levels of automation are used.

* Recapture of CHAMPUS workload.

The trade-offs to these cost savings will include:

* Increased workload and costs associated with providing medication delivery services by mail to those beneficiaries who would otherwise not have easy access.

* An additional investment in facilities, equipment, and information systems required to provide DoD MSP services.

  Or,

* Contract payment costs in excess of what it would cost DoD to maintain its current system of medication distribution.

If these savings meet the 10% return on investment required by DoD in spite of the added workload expected from those beneficiaries currently not using the system, DoD should seriously consider mail-order service.

There is no doubt, however, that DoD beneficiaries will be better served considering mail order services will improve access, and offer them a high degree of convenience. To the extent mail order services reduce workload at individual USTF outpatient pharmacies without manpower cuts, it is also reasonable to expect out-patient pharmacy waiting times to decrease and service improvements for USTF inpatients.

Should the decision be made to provide a MSP option to our beneficiaries either by DoD or contractING out, the following recommendations are offered:

* Limit medications dispensed to those prescribed to treat long-term illnesses. As described in Chapter II, it is inappropriate to dispense acute care drugs by mail.

* Limit medications dispensed by standardizing the MSP formulary. Those drugs not included would continue to be

available through traditional means. A standard MSP formulary will aid in reducing handling costs.

* Encourage, or require if possible, military and civilian physicians to write prescriptions allowing for generic drug substitution wherever possible. As explained in Chapter II, generic drugs are generally less expensive than the same brand name drugs.

Areas of additional study, in addition to the collection of valid data to make use of the methodology described in this thesis, include:

* Examination of adequacy of computer support provided to both USTF pharmacies and material management departments to generate the types of data required for studies of this kind.

* Development of a computer simulation to test the results derived through the use of the methodology used in this thesis, and to examine sensitivity of a MSP system at the micro-level to changes in customer service levels, number and location of MSPs, etc.

APPENDIX A

NUMBERS OF CATCHMENT AREA BENEFICIARIES
OVER THE AGE OF 45 YEARS OLD
SERVED BY 107 DOD USTFS

	NUMBER OF BENEFICIARIES				
USTF	0-15000	15K-25K	25K-45K	45K-65K	65K+
ARMY					
BASSETT	1408				
BAYNE	3944				
BLANCHFIELD	9333				
BLISS	5707				
CUTLER		24991			
DARNALL		16787			
DEWITT			34401		
EISENHOWER		15789			
EVANS		16191			
FITZSIMONS			27901		
FOX	11514				
HAWLEY	9261				
HAYS		15077			
IRELAND		15223			
IRWIN	4772				
KELLER	12441				
KENNER	13763				
KIMBROUGH			25613		
LETTERMAN		19551			
LYSTER	9511				
MADIGAN				45571	
MARTIN		18943			
MCDONALD	10980				
MONCRIEF		16904			
MUNSON	13377				
NOBLE	7543				
PATTERSON	13009				
REYNOLDS	11047				
TRIPLER		21141			
WALSON		17181			
WALTER REED		21510			
WEED	572				
WILLIAM BEAUMONT		22971			
WINN	7762				
WOMACK		24799			
WOOD	5525				
NAVY					
29 PALMS	1746				
ADAK	50				
BEAUFORT	5327				
BETHESDA			32391		
BREMERTON	10251				

NUMBERS OF CATCHMENT AREA BENEFICIARIES
OVER THE AGE OF 45 YEARS OLD
SERVED BY 127 DOD USTFS

	NUMBER OF BENEFICIARIES				
USTF	0-15000	15K-25K	25K-45K	45K-65K	65K+
LEJEUNE	8233				
PENDLETON		21991			
CHARLESTON		19618			
CHERRY PT	5433				
CORPUS CHRISTI	7482				
GREAT LAKES		15551			
GROTON	11314				
JACKSONVILLE			30165		
LEMOORE	6973				
LONG BEACH				59549	
MILLINGTON	12739				
NEWPORT	14341				
OAK HARBOR	5042				
OAKLAND			36031		
ORLANDO			37520		
PATUXENT RIVER	3793				
PENSACOLA		20182			
PHILADELPHIA		24709			
PORTSMOUTH				49131	
SAN DIEGO					76432
AIR FORCE					
COLUMBUS	3202				
LANGLEY	12720				
VANDENBURG	7402				
MARCH			29916		
ENGLAND	4691				
CANNON	1730				
BARKSDALE	11326				
HOMESTEAD	13646				
MATHER			34752		
TYNDALL	9491				
MOODY	4210				
WHITEMAN	2971				
MYRTLE BEACH	6610				
SHAW	7736				
MOUNTAIN HOME	1830				
WURTSMITH	1632				
PLATTSBURGH	1848				
MCCONNELL	6392				
K.I.SAWYER	1233				
GRIFFISS	5415				
LORING	882				
LAUGHLIN	1212				
SEYMOUR JOHNSON	7401				

NUMBERS OF CATCHMENT AREA BENEFICIARIES
OVER THE AGE OF 45 YEARS OLD
SERVED BY 117 DOD USTFS

	NUMBER OF BENEFICIARIES				
USTF	0-15000	15K-25K	25K-45K	45K-65K	65K+
PEASE	11411				
NELLIS		19001			
MCDILL				53605	
REESE	2863				
BERGSTROM		18830			
ELLSWORTH	2948				
BEALE	7373				
WILLIMS		16874			
GEORGE	6033				
LUKE		17752			
HOLLOMAN	3073				
DAVIS MONTHAN		18881			
GRAND FORKS	1073				
MINOT	904				
F.E.WARREN	2833				
FAIRCHILD	9530				
CASTLE	8673				
DYESS	4909				
EAKER	2063				
EDWARDS	4191				
PATRICK		10333			
MAXWELL	13309				
FT SAM HOUSTON			30041		
CHANUTE	3917				
TRAVIS		[illegible]			
OFFUTT	10114				
KEESLER	14773				
ANDREWS		11571			
CARSWELL			33674		
SHEPPARD	6100				
USAF ACADEMY	13761				
ALTUS	2165				
DOVER	7373				
ELEMDORF	6509				
HILL	10692				
KIRKLAND		16019			
LITTLE ROCK	13066				
ROBINS	9915				
TINKER		16209			
SCOTT		16041			
WRIGHT-PATTERSON		16353			
EGLIN		19153			
LACKLAND			29373		
TOTALS	541843	613715	394410	207656	76431

APPENDIX B-1

DoD MAIL SERVICE PHARMACY

by
LCDR J. C. Sherman
Naval Postgraduate School
SMC 1354
Monterey, CA 93943-5000

The following five drugs were identified as being representative of what is currently being dispensed by commercial Mail Service Pharmacies (MSP).

1. Nifedipine
2. Furosemide
3. Albuterol
4. Ibuprofen
5. Diphenhydramine

With information on these five drugs, I hope to establish DoD's capacity requirements for its own MSP. Please provide the following information for each drug in its solid oral form and the inhalant form. Where a drug is prescribed in different strengths please consolidate data.

a. Number of prescriptions filled by month for the past 12 months.
b. Age of patient for whom the prescription was dispensed over the last four months.

Please use the two forms enclosed to compile this information and return to me by fax (408) 646-2138 by 8 November 1991. If you have any questions please leave a message at (408) 646-2536, AV 878-2536. Your assistance is greatly appreciated.

COMPILE NUMBER OF PRESCRIPTIONS FOR EACH DRUG BY MONTH HERE.

	OCT 90	NOV 90	DEC 90	JAN 91	FEB 91	MAR 91
NIFEDIPINE						
FUROSEMIDE						
ALBUTEROL						
IBUPROFEN						
DIPHENHYD						

	APR 91	MAY 91	JUN 91	JUL 91	AUG 91	SEP 91
NIFEDIPINE						
FUROSEMIDE						
ALBUTEROL						
IBUPROFEN						
DIPHENHYD						

COMPILE AGE OF PATIENT RECEIVING PRESCRIPTION HERE.
(Place the number of patients in the ranges provided.)

	NIFEDIPINE	FUROSEMIDE	ALBUTEROL	IBUPROFEN	DIPHENHYD
< 44					
45-54					
55-64					
65+					

APPENDIX B-2

DoD MAIL SERVICE PHARMACY

by
LCDR J. C. Sherman
Naval Postgraduate School
SMC 1354
Monterey, CA 93943-5000

The following five drugs were identified as being representative of what is currently being dispensed by commercial Mail Service Pharmacies (MSP).

1. Nifedipine
2. Furosemide
3. Albuterol
4. Ibuprofen
5. Diphenhydramine

With information on these five drugs, I hope to establish the potential savings for DoD due to stock consolidation of maintenance type medications at a centralized MSP location. Please provide the following information for each drug in its solid oral or inhalant forms. Where a drug is stocked in different strengths or unit of issue, please consolidate data as follows:

a. Dollar ($) value of average annual inventory.
b. Square footage assigned to inventory.
c. Number of times ordered in the last 12 months.
d. Dollar value of loss due to obsolescence, expiration or shrinkage over the last 12 months.
e. Average on hand quantity of normal stock and safety stock expressed in the appropriate unit of issue.

In addition, I need the following information on your overall operations which you may fill in here:

a. Dollar value of average annual inventory. __________
b. Warehouse square footage required to store inventory. ______________
c. Estimated cost to process an order. ________________
d. Customer service level (CSL) or protection level used to determine stock requirements. This is the percentage of orders you are prepared to fill given your stock on hand. For example, a 99% CSL indicates you expect to be able to fill 99 out of every 100 orders. ________________

Please use the form enclosed to compile this information and return it and this page to me by fax (408) 646-2138 by 1 November 1991. If you have any questions please leave a message at (408) 646-2536, AV 878-2536. Your assistance is greatly appreciated.

PROVIDE DATA ON EACH OF FIVE DRUGS HERE.

NIFEDIPINE

a. Dollar ($) value of average annual inventory. ______

b. Square footage assigned to inventory. ______________

c. Number of times ordered in the last 12 months. _____

d. Dollar value of loss due to obsolescence, expiration or shrinkage over the last 12 months. ____________

e. Average on hand quantity of normal stock and safety stock expressed in the appropriate unit of issue. ______________

FUROSEMIDE

a. Dollar ($) value of average annual inventory. ______

b. Square footage assigned to inventory. ______________

c. Number of times ordered in the last 12 months. _____

d. Dollar value of loss due to obsolescence, expiration or shrinkage over the last 12 months. ____________

e. Average on hand quantity of normal stock and safety stock expressed in the appropriate unit of issue. ______________

ALBUTEROL

a. Dollar ($) value of average annual inventory. ______

b. Square footage assigned to inventory. ______________

c. Number of times ordered in the last 12 months. _____

d. Dollar value of loss due to obsolescence, expiration or shrinkage over the last 12 months. ____________

e. Average on hand quantity of normal stock and safety stock expressed in the appropriate unit of issue. ______________

IBUPROFEN

a. Dollar ($) value of average annual inventory. ______

b. Square footage assigned to inventory. ______________

c. Number of times ordered in the last 12 months. _____

d. Dollar value of loss due to obsolescence, expiration or shrinkage over the last 12 months. ____________

e. Average on hand quantity of normal stock and safety stock expressed in the appropriate unit of issue. ______________

DIPHENHYDRAMINE

a. Dollar ($) value of average annual inventory. ______

b. Square footage assigned to inventory. ______________

c. Number of times ordered in the last 12 months. _____

d. Dollar value of loss due to obsolescence, expiration or shrinkage over the last 12 months. ____________

e. Average on hand quantity of normal stock and safety stock expressed in the appropriate unit of issue. ______________

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